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# How to Rationally Use Information Diagnostic Technologies in Family and General Medicine Practice

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## Review

### SUMMARY

New discoveries in technology indeed enabled significant improvement of health care in the last three decades. Only during the last few years a significant breakthrough is achieved in the field of antiviral drugs, biotechnology, digital diagnostic technology, molecular diagnosis, tissues and organs transplantation as well as surgical and information technologies, which all contributed to the improvement of health care. Rapid growth of medical technology has led to the increase in costs of health care, increased access to these technologies and improvement of health care that is permanently encouraging the further development of technology. Technology encompasses the skills, knowledge and ability to understand, use and create useful things. It is the practical application of knowledge. Evaluation of health technology is the systematic evaluation of characteristics, results or impact of health technologies. The primary purpose of evaluation is to provide information to responsible parties for the technology in the health care system, which will be used in decision-making and introduction of these technologies. Information technology in medicine and health care represents all medical and health technology in the process of work, monitoring and evaluation done using computer technology. Progress of medical science in recent years especially needs to thank to the development of information technologies. The health care system of Bosnia and Herzegovina is currently operating in the two sub-systems of primary health care. One is inherited from the past system, in which the primary health care is provided by general practitioners, specialists in general practice, as well as gynecologists, pediatricians and pulmonologists, and the second subsystem occurs when in PHC is introduced the system of family medicine doctors and family medicine specialists. Family medicine, based on the concept of orientation towards the methods which are more effective, rational and cost-effective health care, use of defined procedures and evidence-based medicine, and more adequate education can empower and stimulate general practice doctors, especially family medicine specialists, who have passed various forms of training and courses in this area, to more rational and efficient use of diagnostic technology in their daily practice, without unnecessary duplication of tests. With this they make savings to the healthcare system, improve the financial position of overall health system, especially in the PHC segment, increase satisfaction of doctors providing that health care, but also the users of health services.

**Key words:** information diagnostic technologies, evaluation, effectiveness, primary health care

## 1. INTRODUCTION

New discoveries in technology indeed enabled significant improvement of health care in the last three decades. Only during the last few years a significant breakthrough is achieved in the field of antiviral drugs, biotechnology, digital diagnostic technology, molecular diagnosis, tissues and organs transplantation as well as surgical and information technologies, which all contributed to the improvement of health care. Rapid growth of medical technology has led to the increase in costs of health care (1), increased access to these technologies and improvement of health care that is permanently encouraging the further development of technology. In a time of growing pressure of expensive technology and the progressive increase of its use, there is a need for well-established information that could help in making the decision whether to develop a technology or not, buy it or not, use it or not, pay for its use or not, etc. This led to the raise and development of diverse methods for assessment of health technologies. In fact not only by the participating health professionals, but multidisciplinary research of experts from various fields of science (technology, biotechnological, economic and social sciences ...).

Evaluation of technology use in health care is part of health care policies of most developed western countries. On the basis of numerous and comprehensive estimations recommendations and algorithms on the use of technology are made. The situation in Bosnia is not even similar to this. Fragmented health care system does not give the power of decision making, in the process of creating health policy and the ability to control the use of health technologies. Resource management is left to health professionals who are not trained in the organization, economics and decision-making, and not to mention the use of health assessment technology in our region.

Beginnings of technology developments evaluations started from the mid-1960s (14, 16), when in modern society arises more critical role towards technology and especially after the appearance of sometimes unintentional unwanted

consequences after use of some of them. Early evaluations included technology in conjunction with petro chemistry, pesticides, automotive industry, and nuclear energy (2). The first software for the assessment of health technology is established 1975 in the US (3). Evaluation of medical technology since the period of its occurrence is reflecting in its social, ethical, legal and political importance. Among these technologies were contraception, organ transplantation, artificial organs, technologies to support life for terminally ill, genetic research and genetic therapy, stem cell research, etc. (4).

## 2. TERMS AND DEFINITIONS

Technology encompasses the skills, knowledge and ability to understand, use and create useful things. It is the practical application of knowledge. According to the World Health Organization (WHO) technology in health care includes equipment, machinery, medical supplies and drugs (including medicines) and other things that are used in care for patients. In a broader sense, technology has a wide range of assets that includes not only hardware (equipment, medicines, sanitary material), but also the procedures of health care and the organization of care for the patients (5). So universal technological model consists of hardware and software, a brain-ware and org-ware (6).

Hardware stands for the physical structure and logical layout of equipment necessary to execute certain tasks. That would be a different medical devices (X-ray machine, ultrasound machine, laboratory equipment and accessories, computer equipment), then drugs and medical supplies.

Software includes all the necessary knowledge about how the hardware is used to perform tasks. It would be different written documents, operating and application software in the devices that have digital electronic support (programs for ultrasonic devices ...).

Brain-ware includes knowledge and expertise that are essential to be able to perform tasks, and

Org-ware includes the necessary organizational structure so that a technological process could be implemented.

All these four components represent a technological package (6), and depending on how many and in which manner a component is included in this package we can speak about medical technology, or technology in health care. Namely medical technology includes hardware, software and knowledge of technology, while the medical technology would include the organization of the technology process within the organization of health services.

Evaluation of technology is a kind of political studies designed to ensure information about the potential impact and consequences of new technologies or significant change of some older technologies (14, 16). Information relating to the direct or indirect consequences, usefulness or harm in the application of technology, short-term or long-term social consequences ... The aim of technology evaluation is to provide the decision makers with information about possible alternatives (16).

When we talk about the value of medical technology we think about the process that reviews and informs about the nature of medical technologies used in health care, such as safety, efficiency, features, indications of use, cost, cost effectiveness, as well as social, economic and ethical con-

sequences (14). International network of agencies for health technology assessment reports that the evaluation of health technology is a multidisciplinary field of political analysis. It is used to study medical, social, ethical and economic implications of development, diffusion and use of health technologies.

As previously mentioned technology is practical application of knowledge. Health technologies can be described with the three features (7, 14, 16):

- Material nature
- Its purpose, and
- Degree of maturity and acceptance of changes

When we talk about the **material nature**, there are various categories of medical technology, so we can say that in health technologies include medicines, vaccines, blood products, appliances, equipment and supplies, medical and surgical procedures, and systems to support the health system, like health information system, laboratories, blood banks, and various systems for monitoring, organization and management systems.

Health technologies can also be grouped according to their **purpose** in the health care system, so we can speak of *preventive technologies* which, for example include immunization, control of intra-hospital infections or supply with purified drinking water. The preventive technologies include also various research studies with the aim of discovering the risk factors or the early stages of disease (screening: uterus cancer test, screening mammogram, tuberculin test ...). According to the use of technology it can be *diagnostic* and reveal the cause, nature and seriousness of illness. Health technologies can be designed for *treating diseases* if they are designed to repair or maintain health status of the patient, prevent further damage or problems. They may also have use of *rehabilitation or reconstruction* of physical and mental abilities of the patients. This division is not strictly a categorical one, but identify some technology diagnostic groups which may be used in preventive or therapeutic purposes, and some borderline or hybrid technologies are a combination of medicines, appliances and other categories of health technologies (for example, photodynamic therapy, in which the drugs are activated by applying laser air ...).

According to the **degree of maturity or the application** of technologies may be those that will appear in the *future*, and now are in stage of reflection or in the early stage of development. Technologies may be in the *experimental stage* when it is examined in the laboratory on the animal or other models, the *phase of testing* when conducting a clinical trial of the individual states or indications. When the technology are *accepted and confirmed* considering their standard introduction to the individual states or indications, and in general use. The next stage in the maturity of some technologies is *out of date* technology that should be replaced by other technologies or is declared inefficient or even adverse.

## 3. EVALUATION OF HEALTH RELATED TECHNOLOGIES

Evaluation of health technology is the systematic evaluation of characteristics, results or impact of health technologies. The primary purpose of evaluation is to provide

information to responsible parties for the technology in the health care system, which will be used in decision-making and introduction of these technologies. Evaluation of health technologies is carried out by interdisciplinary teams using strict analytical methods (14). Information will be provided to different groups and organizations, including the regulatory agency (the quality control of medicines), manufacturers of medical technology, those working in healthcare, financier of health care, patients, clinician, health professional associations, hospitals, legal systems and social political boards (7, 8, 3, 14).

In many cases Evaluation of medical technology contributes to improvement of health care, especially in supporting the development and restoration of a wide range of standards, guides and other aspects of health care (14).

Basic orientations in evaluation of health technology are:

*Technology-oriented evaluations* where the intention is to determine the influence or characteristics of an individual technology. For example, government organizations want to determine the clinical, economic, social, professional or economic impact of cancer screening, cochlear implants or other interventions.

- *Problem-oriented evaluations* are focused on solutions or strategies for managing specific problems and which alternatives or complementary technologies can be used. For example diagnostics of hip dislocation in children must follow clinical guides that include clinical history, physical examination, radiology and digital imaging technology ...

- *Project oriented evaluations* are carried out in individual research projects, institutions or other programs (9, 14).

#### 4. FEATURES AND IMPACT OF HEALTH TECHNOLOGIES EVALUATION

Evaluation of health technologies must include the study of one or more characteristics and impact of health technologies or program. Generally they are: *Technical features*—are those which relate to the ability of performing some work and compliance with the plan, composition, production process, tolerance, reliability, ease of use, maintenance ...

*Safety*—Assessment of the acceptability of risk in the use of technology in a given situation. *Efficiency and effectiveness*—referred to whether applied technology improves the patient's health, relying on the achieved results and the health condition of the patient. Efficiency refers to the usefulness of technology used for certain problems in ideal situation, for example, as part of the protocol which is carefully managed in controlled research. Effectiveness refers to the usefulness of technology used for specific problems within the general, common situations, for example, by doctors in general hospital for different patients. Additionally evaluation may include *economic characteristics* and the *impact* of applied technology, and its *social, legal, ethical and political* influence. Health technologies have a wide range of micro and macro economic impact. Microeconomic effects are related to cost, commissions, and levels of payment in relation to certain technologies. They also include a comparison of resources required in the application of the results for individual programs such as cost effectiveness, cost utility and cost benefit. Macroeconomic effects are achieved by new

technologies that give effect to the cost of national health care, health care resource allocations... (3, 14, 16).

#### 5. EFFECTS OF DIAGNOSTIC TECHNOLOGIES

Relations between the majority of preventive, therapeutic and rehabilitation technology, and the results of their application can be determined directly from the relationship between action and reaction. Relation between the use of diagnostic technologies and the results of their application is indirect (3, 14), they provide information about a particular situation and on the basis of this information is used for other technologies that will result from the produce. Thus the results of use of certain therapeutic, preventive or rehabilitation technology speak about the value of used diagnostic technology indirectly. The value of diagnostic tests can range from good to inadequate.

Immediate purpose of diagnostic tests is to determine the presence or rarely absence of illness or other health conditions.

Technical execution of diagnostic tests depends on many factors. Among them are the accuracy and validity of the test, tester's ability to interpret the test and the relation between the disease and limitations of markers used in the test to confirm or exclude disease. These factors determine the ability of diagnostic tests to confirm the disease when it is present or to exclude it if it is absent (3).

Diagnostic technologies can have four main results. **True positive** result is when the diagnostic test confirms present disease. **True negative** result when markers are absent in those for which are not sick. **False positive** result when the test verifies the existence of markers in cases where the disease is absent. **False negative** result is when the markers are not confirmed but the disease is present (3, 7, 10, 14). The results of the application of technology can be expressed qualitatively and quantitatively. Depending on the result of different types and methods for calculating the validity of applied technology.

*Operational characteristics* (3, 7, 10, 14) of diagnostic procedures are measures of technical performance of these technologies. They are based on the probability of events of one of the four results of technology application. The two most commonly used operating characteristics of diagnostic tests are sensitivity and specificity. Specificity is a measure of the ability of the test to correctly exclude the illness in healthy people, and sensitivity is a measure of the ability the test to identify the disease when it is present. If you rank the results in the table, then from it we can derive a formula to calculate specificity and sensitivity of the test.

Test results	Disease	
	Present	Absent
Positive	TP	FP
Negative	FN	TN

Sensitivity is calculated from the relation

$$Sz = \frac{TP}{TP+FN}, \text{ and specificity}$$

$$Sp = \frac{TN}{TN+FP}.$$

Perfectly valid test would have sensitivity and specificity values of 1, however, there is a little of such diagnostic tests. Usually there is a clash between sensitivity and specificity. If a specific test has more false negative than false positive, and if it is more sensitive it has more false positive than false negative. If we take only specificity and sensitivity they does not reveal whether a particular patient really has the disease if test positive, or whether the patient has no disease if the test is negative, the clinician wants to know whether his patient has or does not have a disease. These possibilities are included in two other operating characteristics. These are: **positive predictable value** – proportion of those patients with positive test who actually have disease. It is calculated by formula

$$Ppv = \frac{TP}{TP+FP}$$

**Negative predictive value** – proportion of those patients with negative test which does not have illness (10). Formula for calculation is

$$Npv = \frac{TN}{TN+FN}$$

Values of specificity, sensitivity, positive and negative predictable values are not always equal for one diagnostic test; they change depending on the prevalence of illness in tested population. If the disease is very rare, although the test has a high sensitivity and specificity it may have a small positive predictable value, if you generate many more false positive than false negative results.

On the other hand, technical performance, effects and results of application of diagnostic technologies are less obvious than with other technologies. How requirements for the knowledge increases so the certain technologies are affecting the health results, diagnostic technology will display their efficiency/effectiveness accordingly.

Efficiency (or effectiveness) of diagnostic technology may be determined by a series of demands that go from the technical capacity of technology to the needs in terms of changes of their application and their effectiveness. So we must pay attention to the following (7, 14):

- *Technical possibilities.* Is the technology reliable and does it give reliable results?
- *Diagnostic precision.* Does the technology contribute to making precise diagnosis?
- *Diagnostic effect.* Does the results obtained influence on other diagnostic technologies, or does the applied diagnostic technology can replace some other?
- *Therapeutic effect.* Do the findings influence the selection of treatment?
- *Consequences (outcomes) to patients.* Does the use of diagnostic technology contribute to improvement of patient's health?
- *Cost effectiveness.* Does the use of diagnostic technology improve effectiveness of the health care compared to alternative interventions?

If medical technology is not effective at any step listed, it will probably not be effective in any of the next steps. In any case, we should be able to qualitatively describe the way

in which technology can influence the diagnostic accuracy, diagnostic impact, therapeutic impact, the results of diagnostic and cost-effectiveness, and how these effects can be measured, approximate level needed so the technology is implemented.

## 6. BASIC STEPS IN EVALUATION OF HEALTH TECHNOLOGIES

There is great variability in the sampling, a selection of methods and the level of details in the evaluation of health technologies. However, many activities in this process include some of the basic steps (7, 3, 14, 15, 16).

- Determining goals of the evaluation
- Listing evaluation problems
- Limiting evaluation area
- Renewing or making documentation
- Gathering primary data (as required)
- Evaluation/interpretation of documentation
- Organizing/synthesis of the documentation
- Forming conclusions and recommendations
- Dissemination of findings and recommendations
- Monitoring influence

Not all evaluation programs require all the listed steps, and it is not necessary to conduct them in a linear fashion as they are presented. Many of the evaluation rely on methods of integrating review and synthesis of new data from a pre-existing primary explored data which are published or from the collection of epidemiological and administrative data in the institutions. Some evaluations are trying to include multiple cycles of feedback, which have already been interpreted and integrated prior to assessment completion. Another framework for assessment of medical technology is offered by the (11) European Collaboration for Health Technology Assessment and it looks like this:

- Registering evaluation demands/identification of assessment need
- Determining priorities
- Starting evaluation
- Conducting evaluation
  - Defining policy
  - Making of evaluation protocol
  - Gathering basic information's/determinants of technology status
  - Defining research problems
  - Data sources, evaluation of documentation and gathering documents on following:
    - Safety
    - Efficacy/efficiency
    - Psychological social and ethical principles
    - On organization and profession
    - On economic issues
  - Test elaboration of the discussion, conclusions and recommendations
  - External review
  - Publishing final evaluation report and summary
- Publishing results – dissemination
- Use of evaluation results
- Updating and improving evaluation

So as we see the data can be primarily collected prospec-

tively or retrospectively, or can be generated as secondary data from a previously done research (so-called synthetic or integrating data). There is no standard methodological approach to evaluate the implementation of health technologies. Certain with different evaluation, requirements for resources and other factors, evaluation programs tend to rely on different combinations of methods.

## 7. GATHERING INITIAL DATA

Significant and varied list of methods includes primary data collection. For example, experiments such as randomized controlled research, prospective but uncontrolled research, observation studies such as case control studies, cross sectional studies, as well as simpler investigations such as a series of cases, a report on the event or anecdote (7, 12, 14). These methods must be described and categorized with multiple attributes, that is, whether prospectively or retrospective, interventional (manipulation) or perceptive, controlled or uncontrolled or with some other characteristics.

## 8. COST AND BENEFIT ANALYSES IN USE OF DIAGNOSTIC TECHNOLOGIES

Studies on the costs and related economic implications include a large group of used methods to assess health technologies. Costs data from one or more of such studies are often combined with data from epidemiological, primary clinical studies and other sources are used for conducting profitability analysis and other research of costs, which include the measurement of health and economic impact of health technologies (3, 7, 13, 14).

Main types of cost analysis

- Cost-of-illness analysis – determination of economic impact of illness or state, for example. smoking, arthritis, including the cost of necessary treatment
- Cost-minimization analysis – determining least expensive intervention which will give same effect
- Cost-effectiveness analysis – comparison of cost in currency with effects in quantitative and non currency unity, e.g. reduction of mortality or morbidity
- Cost-utility analysis – is a form of cost analysis which compares cost in currency units with effects according to their impact, measured on patients, e.g. QALY
- Cost-consequence analysis – is a form of cost efficiency analysis which represents costs and effects in discrete categories without its collection or measurement
- Cost-benefit analysis – compares costs and benefit, which are both quantified in currency units

For cost-minimization analysis, cost-effectiveness and cost-utility analysis it is necessary to include comparisons of alternative interventions, and cost-benefit analysis typically includes a comparison of alternative technologies, though it is not necessary.

## 9. PRINCIPLES FOR EVALUATION OF DIAGNOSTIC TECHNOLOGIES

In the past thirty years, the use of health technologies is rapidly increasing, and the price of these technologies is growing significantly more than the price of healthcare. Moreover, there are indicators that diagnostic technologi-

es spend a significant portion of our health care resources. Therefore, it is very important to establish strict criteria for the use of diagnostic technology and one of the ways that contributes to this is the evaluation of diagnostic technologies. Why it is important to evaluate can be viewed from many perspectives (16), but three are particularly relevant (3): in relation to the patient, in relation to society and in relation to doctors. We should take into account that each of these perspectives should be the referent of its safety, efficiency and economic usefulness.

### 9.1. Regarding patient

Effect of diagnostic tests directly concerns the patients. The patients are anxious to improve their health status. With the patient's point of view the most important diagnostic features are the safety and efficiency. Economic aspects are often in the background. Safety means that the test should not produce an unacceptable degree of harm to the patient. After safety for the patient is certainly important the effectiveness of potential benefit for the patient. Efficiency of diagnostic tests should be measured in terms of when they met the safety, technical excellence, validity, and therapeutic impact. The first step to assess the effectiveness of a diagnostic technology is to evaluate its technical capabilities, followed by evaluation of diagnostic accuracy (sensitivity and specificity). When assessing the efficiency also observed are therapeutic and diagnostic impact of the applied technology. Although the primary concern of patients is not economic nature, however, some costing procedures and requirements for high-quality health care are clearly important to them. Unnecessary tests, inappropriate treatment and failure could prove as very expensive.

### 9.2. From social perspective

Social concerns in relation to the efficiency and safety of medical technology have two components. The first is reflected in the action of government, as guardian of public safety. A second component of this interest is economic, because if the test is not effective or safe it is neither economical. In addition, many analysts agree that new technologies represent an important factor in increasing costs of health care. US Office of Technology Assessment (OTA) estimated that the technological component of health care is responsible for 30 percent increase of health spending in the period from 1977 to 1982 (3).

Methods for measuring the effectiveness of the application of medical technology are the analysis of viability, which is measured by how much money is available in certain health outcomes. The results of the analysis is often presented as cost per unit of output (average cost effectiveness), or change the cost-per-change outcomes (limiting cost-effective) (3).

From the perspective of social efficiency analysis helps decision making that technology should be recommended as a cost-effective.

### 9.3. From doctor's perspective

The importance of diagnostic technology and evaluation of these technologies from the standpoint of doctors must be explored in the context of its role as protector of the interests of the patient and the community. On the one hand, patients were subjected to diagnostic tests

following to request by doctors and therefore their common interest is safety and efficiency in implementation of the technology. The purpose of the use test for clinician is double. First, it can get reliable information about the patient. Second, the test results affect the decision on further procedures to be undertaken in order that doctor resolve patients needs. Test will have purpose only if the clinician can interpret the results, and information for proper interpretation of test results clinician receives by adequate access health technologies. Under ideal conditions, the interests of patients and doctors should be the same, because in principle, a doctor working for the benefit of the patient. In addition to well-being of the patient, a doctor must also take into account the financial and legal repercussions of diagnostic errors, and often out of fear that they will not establish the right diagnosis of the patient, so the resort to excessive, irrational use of diagnostic technology.

On the other hand, doctors have to care about the economic efficiency of diagnostic technology. In the growing competition, economic success depends on effectiveness as well as the quality of healthcare. Some new technologies can reduce the consumption of health care, but most of them actually increase it. So if we do not take into account the demand for the already limited health care resources, no matter how great they were, we can come to the point that they no longer exist.

## 10. DIAGNOSTIC TECHNOLOGIES IN PRIMARY HEALTH CARE

Primary health care is the first professional level of health care. It provides integrated and accessible health care from clinicians responsible for a wide range of needs, development of continuing links with patients and work within the family or a community (17). In the Alma Ata Declaration, the World Health Organization has defined the primary health care as essential, based on practical, scientific and socially acceptable methods and technologies that are universally accessible to individuals and families. It is an integral part of the health system of one country and focused on the major health problems of the community and allows creation of developmental, preventive, healing and rehabilitation activities (18). As these activities reflect the social value of a country they are developing in line with economic opportunities, and will vary in different countries. This is the place where the patient for the first time meets with health professionals and about 90% of their health needs are treated at this level (19). Team, which provides health care at the primary level is also different in different countries, but it ranges which assume presence of doctor, general practitioner or specialist in general or family medicine, nurses, and somewhere also social workers, physiotherapists, psychologists, gynecologists, obstetrician, internal diseases specialist, pulmonologist, and pediatricians (18, 20) ... In our conditions primary health care include general and family medicine, health care for women and pregnant women, pediatrics, pneumophisiology, hygiene-epidemiological service, emergency medical aid, dental and laboratory diagnostic work. Administrative units are at the level of health where care is provided or at the local community, and in addition to providing medical

care (diagnosis, treatment and rehabilitation) this includes a range of activities aimed at enhancing and maintaining health. In achieving these tasks the primary health care uses certain technologies which are characteristic for it (or the ones most often used in primary health care). These technologies are necessary to resolve specific health problems and neither one health system can function without some of them. Among them are the so-called medical diagnostic technologies that can be in the form of diagnostic tools or diagnostic procedures. Among the most commonly used technologies are diagnostic laboratories for microbiological, hematological and biochemical procedures, different radiological techniques, ultrasound technology, technology for tracking and analyzing bioelectric potentials of the body, then a different physical diagnostic tests and diagnostic procedures. All they have their own specificity and sensitivity for a particular state of the patient. A specificity and sensitivity of a diagnostic technology depends on many factors. Some of these factors are constant and cannot be changed by these technologies, while others are changeable. Many of these variable factors are related to certain health care system, a certain social-political system, economic situation of the community, or the possibilities for education of health professionals for the application of specific diagnostic technology. Therefore, it is desirable to do assessment of health technology for a specific social-political area. In addition, many of these factors, especially when the health system is not fully equipped, can affect the rational economic use of certain diagnostic technologies. If a health system or medical doctrine determined not use the technology, as is the case with us, then a case can occur that the possibilities of using certain technologies have been left to health professionals who have training only in medical skills, which is definitely not enough for good practice.

In the postwar period, health system the Federation of Bosnia and Herzegovina is in a specific transition state. We have remains of the pre war system of functioning, in addition to the new models of work organization. In primary health care, in transition procedures, the most is done in the development of family medicine, where already are in use defined protocols for specific procedures, but they are not obligatory, nor are they adapted to our requirements, but there is the intention of their use. In addition to family medicine also exist general medicine where it is on medical doctrine and the discretion of each practitioner in each individual case. In addition to general and family medicine in primary health care in our country is also classified ambulatory pediatric practice, the protection of old women and obstetrics. They have trough their specialty gained some extended knowledge about the use of specific diagnostic technologies and that use for sure in some aspects is different from the same in general or family medicine.

## 11. INFORMATION DIAGNOSTIC TECHNOLOGIES AND THEIR PRACTICAL BENEFIT

Information technology in medicine and health care represents all medical and health technology in the process of work, monitoring and evaluation done using computer

technology (21). Progress of medical science in recent years especially needs to thank to the development of information technologies. Intelligent techniques that handle the data, suppress the older ones, whose operation required lot of effort and energy. Information technologies are much faster, more realistic and provide more comprehensive data. Today's technologies are used in medicine in general and in health care, either in therapeutic, diagnostic or rehabilitation purposes cannot be imagined without the components of information technology (21). So when we talk about practical modern diagnostic technologies we can speak of diagnostic information technologies. So for example the development of microprocessors enables their wide use in biomedical instruments for measuring, monitoring and display in the physiology, radiology, clinical, nuclear medicine, laboratories, etc. Many instruments and procedures for diagnosis in primary health care using information technology for diagnosis. Imaging technology such as X-ray and ultrasound cannot even be imagined today, with any data processing in micro computers. They found their place in laboratory and many other instruments.

Progress of science and technology in 20th century is great contribution to human health. New technologies and procedures are also developing rapidly, and there is such economic and social motivation for their use and evaluation of their safety, efficiency and cost effectiveness, as well as consideration of their social and ethical consequences. On the one hand, increasing is the pressure of expensive technology that burden already limited health care resources, the other is desire to be the more efficient, safer and in help the patient which creates a conflict situation for decision makers. The need for well-established information that could help in making decisions about the introduction or use of certain technologies is real and always growing. This led to the development of various methods for the assessment of health technologies. Factors that influence the characteristics of diagnostic technologies, such as efficiency, effectiveness, safety, cost effectiveness ... may be constant, but also changeable. Constant are those who depend on the same technology (protocol performance, mechanical construction, used materials ...), while factors such as social environment, economic opportunities, and human resources ... can be changed from the time to time, and they constitute the changing factors. Therefore it is necessary to evaluate efficiency, effectiveness and cost-effective diagnostic technologies, and on the basis of obtained results try to influence the variable factors in terms of improving diagnostic procedures.

Economical and social political environment disorganized health care system and high costs caused by the use of diagnostic technologies require aggressive measures in terms of achieving the better quality, more efficient and cheaper, in other words more rational health services. In many countries the number of diagnostic tests indicated in primary health care is growing, but at the same time permit algorithms based on the evidence makes many these tests to be considered unnecessary (22).

What would be the measure of rationality? It can be seen by the patient, by society and by the health institutions. Patient definitely wants a quality, comfortable and reliable

diagnostic procedure. So it must give an answer to the question whether or not there is a disease with as less as possible unpleasant sensations and as less possible negative consequences associated with it—the *effectiveness and safety*. The society is also interested with the aspect of a guardian of public safety for the safety of technology but also for its economy due to limited resources. In other words to with less cost achieve the best result. In the case of diagnostic technologies that will be achieved by applying efficient, safe and inexpensive technologies in situations where its application is really necessary, because unnecessary tests, inappropriate treatment and disability are very expensive – e.g. *efficiency, effectiveness, and indicated applications*. Health services were also interested in efficient and safe diagnostic procedure. On the other hand, the desire to include all those who can eventually have a certain disease, i.e., to ensure the eventual failures they often unnecessarily expand the scope.

## 12. WHAT ARE THE POSSIBILITIES AND PERSPECTIVES FOR RATIONAL USE OF DIAGNOSTIC IT IN PRIMARY HEALTH CARE IN BOSNIA AND HERZEGOVINA?

The health care system of Bosnia and Herzegovina is currently operating in the two sub-systems of primary health care. One is inherited from the past system, in which the primary health care is provided by general practitioners, specialists in general practice, as well as gynecologists, pediatricians and pulmonologists, and the second subsystem occurs when in PHC is introduced the system of family medicine doctors and family medicine specialists. In addition to this in the post-war period there is intensified continuous medical education and other forms of medical education. The question is whether health education, a different arrangement of the health system, different principles of health care provision, and different work conditions may give different effectiveness, utilization and cost effectiveness in the use of certain diagnostic technology? Problems that are currently striking the existing PHC system are as follows:

- Irrational application of diagnostic information technology in the existing concept of primary health care depends on degree of medical education of health professionals, the existing technological resources, working conditions, the concept of primary health care and the application of accreditation standards in primary health care.
- There are significant differences in the utilization of diagnostic information technologies between doctors of family medicine and the doctors in general medicine.
- There are significant differences in the effectiveness of information diagnostic technologies use between family doctors and doctors in general medicine.
- There are significant differences in the economic effects of applying information technology in diagnostics between family doctors and doctors in general medicine.

Family medicine, based on the concept of orientation towards the methods which are more effective, rational and cost-effective health care, use of defined procedures and

evidence-based medicine, and more adequate education can empower and stimulate general practice doctors, especially family medicine specialists, who have passed various forms of training and courses in this area, to more rational and efficient use of diagnostic technology in their daily practice, without unnecessary duplication of tests. With this they make savings to the healthcare system, improve the financial position of overall health system, especially in the PHC segment, increase satisfaction of doctors providing that health care, but also the users of health services.

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